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DESCRIPTION

SIDE CURTAIN AIR BAG

Technical Field

[0001]

The present invention relates to a side curtain air bag which is designed to protect a head of an occupant inside the vehicle by being expanded and developed during lateral collisions or turnover accidents, and to prevent the occupant from being thrown out of a vehicle.

Background Art

[0002]

The related art side curtain air bags (hereinafter, simply referred to as an air bag) can be seen in reference documents.

Patent Document 1: JP-A-2001-270413

Patent Document 2: JP-A-2001-233155

Patent Document 3: JP-A-2001-328503

Patent Document 4: JP-A-2002-283949

Patent Document 5: JP-T-2002-503581

[0003]

A side curtain air bag module 100, as shown in Fig. 8, is attached along a roof side rail 101 inside a vehicle.

At the time of collision, as shown in Fig. 9, an air bag 103 included in the side curtain air bag module 100 expands and develops in a curtain shape between an

occupant and a side component in a vehicle, such as a door, by gas supplied from an inflator 102, so as to protect the occupant from the side component.

The air bag 103 starts to expand and develop at the initial stage of the collision and comes into contact with the head of the occupant, on the purpose of protection. Therefore, when the air bag expands and develops, if expansive force of the entire air bag 103 is excessively strong thus making the air bag 103 be too hard, the expansive force may harm the occupant. Accordingly, the expansive force of the entire air bag is preferred to be relatively low and soft at the initial stage of the collision, that is, when the air bag expands and develops. [0004]

In the meantime, at the latter stage of the collision, in order to prevent an occupant from being thrown out of a vehicle due to overturn of the vehicle, after a predetermined time from the collision, that is, after the air bag 103 is developed, the air bag 103 needs to have a relatively high tension so as to maintain a position of being expanded in the fullest forward and backward direction in a curtain shape, because it is necessary to prevent the occupant from being thrown out of the vehicle. For this reason, a string 104 is attached to the leading and trailing sides below the air bag 103 to

keep the air bag 103 in the expanded position. One end of the string 104 is attached to the air bag 103, and the other end thereof is attached to a chassis.

Disclosure of the Invention

Problems to be Solved by the Invention

[0005]

However, in the related art air bag 103, when a strong tension is needed after the air bag expands and develops, the tension is set to be high by the string 104 from the time when the air bag starts to develop. Therefore, it is difficult to control the tension of the air bag to be low when the air bag starts to expand and develop, and to be high when the air bag is developed.

It is an object of the invention to provide an air bag which is capable of controlling the tension of the air bag properly and easily.

Means for Solving the Problems

[0006]

According to a first aspect of the invention, there is provided a side curtain air bag which has chambers expanded by gas supplied from an inflator, and expands and develops in a curtain shape at side part of a vehicle so as to protect occupants.

Further, the side curtain air bag includes primary chambers which expand to develop the side curtain air bag;

and a secondary chamber which expands later than the primary chambers to apply an additional tension on the developed side curtain air bag.

Furthermore, the secondary chamber may have an opening communicating with the primary chamber, and may be expanded by the inflow of the gas from the primary chamber.

Further, according to a second aspect of the invention, there is provided a side curtain air bag which has chambers expanded by gas supplied from an inflator, and expands and develops in a curtain shape at side part of a vehicle so as to protect occupants. The side curtain air bag includes a primary chamber which expands so as to protect an occupant; a secondary chamber which applies tension on the side curtain air bag after the side curtain air bag is expanded and developed; and a set of strings, each having one end attached to the side curtain air bag at a joint end and the other end attached to a vehicle at a fixation end, in the forward and backward direction of the vehicle. In this case, when the side curtain air bag expands and develops, the secondary chamber is disposed such that a portion or all of the secondary chamber overlaps a virtual band region, the virtual band region being formed of a first virtual line connecting the respective fixation ends of the one set of strings and a second virtual line connecting the respective joint ends

of the one set of strings.

Further, the secondary chamber may expand later than the primary chamber.

Furthermore, the secondary chamber may have an opening communicating with the primary chamber, and may be expanded by the inflow of the gas from the primary chamber.

According to a third aspect of the invention, there is provided a side curtain air bag which has chambers expanded by gas supplied from an inflator, and expands and develops in a curtain shape at side part of a vehicle so as to protect occupants. The side curtain air bag includes a primary chamber which expands so as to protect an occupant; a secondary chamber which applies tension on the side curtain air bag after the side curtain air bag is expanded and developed; and a set of strings, each having one end attached to the side curtain air bag at a joint end via an attachment part of the side curtain air bag and the other end attached to a vehicle at a fixation end, in the forward and backward direction of the vehicle. In this case, when the side curtain air bag expands and develops, the secondary chamber is disposed such that a portion or all of the secondary chamber overlaps a virtual band region, the virtual band region being formed of a first virtual line connecting respective upper ends of attachment parts of the one set of strings and a second

virtual line connecting respective lower ends of the attachment parts of the one set of strings.

Further, the secondary chamber may expand later than the primary chamber.

Furthermore, the secondary chamber may have an opening communicating with the primary chamber, and may be expanded by the inflow of the gas from the primary chamber.

According to a fourth aspect of the invention, there is provided a side curtain air bag which has chambers expanded by gas supplied from an inflator, and expands and develops in a curtain shape at side part of a vehicle so as to protect occupants. The side curtain air bag includes a primary chamber which expands so as to protect an occupant; a secondary chamber which applies tension on the side curtain air bag after the side curtain air bag is expanded and developed; and a set of strings, each having one end attached to the side curtain air bag at a joint end via the attachment part of the side curtain air bag and the other end attached to a vehicle at a fixation end, in the forward and backward direction of the vehicle. In this case, when the side curtain air bag expands and develops, the secondary chamber is disposed such that a portion or all of the secondary chamber overlaps a virtual band region, the virtual band region being formed of a first virtual line connecting the upper end of the

attachment part of one string and the fixation end of the other string, and a second virtual line connecting respective lower ends of the attachment parts of the one set of strings.

Further, the secondary chamber may expand later than the primary chamber.

Furthermore, the secondary chamber may have an opening communicating with the primary chamber, and may be expanded by the inflow of the gas from the primary chamber.

Effects of the Invention

[0007]

The air bag according to the invention includes the primary chamber which expands to develop the air bag; the secondary chamber which applies an additional tension on the developed air bag, and the secondary chamber gradually expands later than the primary chamber is expanded. Therefore, it is possible to gradually increase the tension of the entire air bag. Accordingly, it is easy to properly control the tension of the air bag.

As a result, at the initial stage of the collision, the air bag protects the head of occupants while maintaining relatively low tension of the entire air bag so as to be soft, and sequentially, at the latter stage of the collision, the air bag prevents the occupants from being thrown out of the vehicle by turnover accidents

while maintaining relatively high tension of the air bag so as to be developed to the fullest.

Further, the secondary chamber is disposed such that a portion or the entire secondary chamber overlaps a virtual band region. The virtual band region may be formed of a first virtual line connecting the respective fixation ends of the one set of strings and a second virtual line connecting the respective joint ends of the one set of strings, the virtual band region may be formed of a first virtual line connecting respective upper ends of attachment parts of the one set of strings and a second virtual line connecting respective lower ends of the attachment parts of the one set of strings, and the virtual band region may be formed of a first virtual line connecting the upper end of the attachment part of one string and the fixation end of the other string, and a second virtual line connecting respective lower ends of the attachment parts of the one set of strings. Therefore, the tension created by the expansion of the secondary chamber, after the primary chamber is expanded and developed, is applied on the primary chamber through the respective virtual band regions. As a result, it is possible to prevent the occupants from being thrown out of the vehicle by turnover accidents or the like while maintaining high tension of the entire air bag.

Best Mode for Carrying Out the Invention

[0008]

Hereinafter, an air bag 1 according to a first embodiment of the invention will be described with reference to the accompanying drawings. Fig. 1 is a cross-sectional view showing the entire air bag 1 according to a first embodiment of the invention. Fig. 2 is an enlarged view of main parts of the air bag according to the first embodiment of the invention. Fig. 3 is a cross-sectional view of the air bag 1 taken along the line C-C of Fig. 2. Fig. 4 is a graph showing the internal pressure change of primary and secondary chambers 3 and 2 according to the first embodiment of the invention.

Further, in the embodiment of the air bag of the invention, forward, backward, left, and right directions are directions in which the air bag attached to the inside of a vehicle expands and develops in a curtain shape.

[0009]

The air bag 1 according to the first embodiment is a pouch-shaped air bag formed by integrally superimposing a sheet material having the section shown in Fig. 1 upon another sheet material having a section that is axisymmetrical to the section shown in Fig. 1.

The air bag 1 may be formed of two sheets of texture, such as textile that is woven into a predetermined pouch-

shape; otherwise, may be formed of one sheet of textile that is initially woven into a pouch-shape.

As shown in Fig. 1, the air bag 1 is provided with a plurality of front seat inflation parts 3, 4, 5, 6, and 7; a plurality of back seat inflation parts 8, 9, and 10; a gas supply passage 11; a front non-inflation part 12; an intermediate non-inflation part 13; a back non-inflation part 14; a plurality of attachment pieces 15 toward a roof side rail; a gas supply port 16; and a secondary chamber 2.

[0010]

The front seat inflation parts 3, 4, 5, 6, and 7 include a plurality of first, second, third, fourth, and fifth chambers 3, 4, 5, 6, and 7. The back seat inflation parts 8, 9, and 10 include a plurality of sixth, seventh, and eighth chambers 8, 9, and 10. The plurality of chambers 3, 4, 5, 6, 7, 8, 9, and 10 is expanded by gas that is supplied from an inflator at the time of initial collision, and functions as the primary chamber which causes the entire air bag to expand and develop.

The gas supply port 16 is disposed on an upper trailing end of the air bag 1. The gas supply passage 11 is disposed above the respective primary chambers 3, 4, 5, 6, 7, 8, 9, and 10 so as to supply gas to the respective primary chambers 3, 4, 5, 6, 7, 8, 9, and 10 from the gas supply port 16. The respective primary chambers 3, 4, 5,

6, 7, 8, 9, and 10 are all open to the gas supply passage 11.

[0011]

The secondary chamber 2 is disposed in front of the first chamber 3 in a row in the forward and backward direction, and the first chamber 3 is disposed in the forefront position of the front seat inflation part. The forefront position actually involves in applying extra tension to the air bag 1 in the forward and backward direction, when the secondary chamber 2 is expanded later than the primary chambers 3, 4, 5, 6, 7, 8, 9, and 10.

The secondary chamber 2, as shown in Fig. 2, has an opening A communicating with the first chamber 3 of the primary chamber, gas of the inflator is supplied to the secondary chamber through the first chamber 3. The size of the opening A is smaller than that of an opening B of the first chamber 3 which communicates with the gas supply passage 11, and the secondary chamber 2 is expanded later than the primary chambers 3, 4, 5, 6, 7, 8, 9, and 10. By varying the aperture of the opening A, the time required for the secondary chamber 2 to expand can be controlled.

[0012]

A leading end 1a of the air bag 1 has a joint end 18b of a string 18 sewn to an attachment part 19 that is disposed at the front non-inflation part 12, and the air

bag is connected to the chassis as the other end of the string 18 is connected to a fixation end 18a that is fixed to the vehicle. Further, a trailing end 1b of the air bag 1 has a joint end 20b of a string 20 sewn to an attachment part 21 that is disposed at an extension protrusion 14a extending backward from the back non-inflation part 14, and the air bag is connected to the chassis as the other end of the string 20 is connected to a fixation end 20a that is fixed to the vehicle. Further, the attachment part 19 and the attachment part 21 may be made of metal that is unlikely deformable even when the air bag 1 expands. Otherwise, the attachment part 19 may be made of deformable materials which deform corresponding to the expansion of the air bag 1, such as an enforced part of an additional sewn product that is strongly sewn to the front non-inflation part 12 by a sewing machine. That is, the attachment parts 19 and 21 involve in the connection the air bag 1 to the chassis by the strings 18 and 20, when the air bag 1 expands and develops; and a strong tension is applied thereon, and thus the attachment part 19 partially needs strength so to bear with the tension. Further, lower ends 19a and 21a and upper ends 19b and 21b of the attachment parts 19 and 21 are attached parts indicating upper and lower ends of the enforced part.

[0013]

Further, in this embodiment, as for the positions of the attachment parts 19 and 21, a virtual line which connects the attachment part 19 and the attachment part 21 inclinedly crosses the air bag 1 in a direction from the attachment part 19 upward the attachment part 21. In addition, the fixation end 20a of the string 20, which is fixed to the chassis, is located above the attachment part 21, the fixation end 18a of the string 18, which is fixed to the chassis, is located substantially at the same height as the attachment part 19. A virtual line which connects these fixation ends 20a and 18a inclinedly crosses the air bag 1, as same as described above. However, various modifications of the attachment parts 19 and 21 and the fixation ends 20a and 18a are possible, according to kinds of vehicles and air bags.

[0014]

In the air bag 1 with this constitution, when overturn of a vehicle or collision occurs, and gas of the inflator is supplied from the gas supply port 16, at the initial stage of the collision, all of the primary chamber 3, 4, 5, 6, 7, 8, 9, and 10 expand and develop the entire air bag 1.

At this time, since force that is applied on the entire air bag 1 to expand and develop the air bag 1 is continuously supplied to the secondary chamber 2 from the

primary chamber 3 through the opening A, the primary chambers 3 to 10 are controlled to be applied with relatively low force, so that the air bag 1 protects the head of an occupant while the air bag 1 is softly expanding and developing. For this reason, the air bag 1 may protect the occupant without harm.

Next, when gas is sufficiently supplied to the secondary chamber 2 later than to the primary chambers, an additional tension is actually applied on the entire air bag 1, which is expanded and developed, in the forward and backward direction, so as to increase the tension applied on the entire air bag 1.

In this way, the air bag 1 with sufficiently high tension assuredly protects the occupant at the latter stage of the collision or at the time of the final overturn of the vehicle, thus reliably preventing the occupant from being thrown out of the vehicle. That is, at the time of collision or overturn of a vehicle, since the tension of the air bag is controlled corresponding to each time, the occupant is not harmed and is reliably prevented from being thrown out of the vehicle.

[0015]

The state of tension applied on the air bag 1 due to the expansion of the secondary chamber 2 will be described with reference to Fig. 3. Fig. 3 is a cross-sectional

view of the air bag 1 taken along the line C-C of Fig. 2. Reference symbol I indicates the initial stage of the collision, that is, a stage when the primary chambers 3, 4, 5, 6, 7, 8, 9, and 10 are completely expanded and the air bag 1 is completely developed after 0 to 100 mSec elapses from the time of detecting collision. II indicates the latter stage of the collision, that is, a stage when the secondary chamber 2 is completely expanded later than the primary chambers 3, 4, 5, 6, 7, 8, 9, and 10 after 4 to 6 Sec elapses from the time of detecting the collision. By the expansion of the secondary chamber 2, the air bag 1 shrinks in the forward and backward direction by a length x, and an additional tension is applied on the air bag 1 that is developed.

[0016]

Fig. 4 is a graph showing the internal pressure change of the primary and secondary chambers 3 and 2 of Fig. 1. ● indicates the internal pressure of the primary chamber 3, ▲ indicates the internal pressure of the secondary chamber 2. The internal pressure of the secondary chamber 2 starts to increase after 1000 mSec from the time of initiating the development, that is, after 1 Sec, and becomes an identical pressure to that of the primary chamber 3 after 4500 mSec from the time of initiating the development. In this way, with the

structure of the air bag 1 shown in Fig. 1, since the secondary chamber 2 gradually expands after the primary chambers 3, 4, 5, 6, 7, 8, 9, and 10 are expanded, it is possible to gradually increase the force for expanding the entire air bag 1.

[0017]

When the air bag 1 expands and develops, the relationship between the position of the secondary chamber 2 and the attachment parts 19 and 21 of the strings 18 and 19, and the fixation ends 18a and 20a of the strings 18 and 20 plays a major role in the function of the air bag 1, the relationship will be describe with reference to Figs. 5 to 7.

[0018]

In Fig. 5, a virtual band region 25 is formed of a first virtual line 23 and a second virtual line 24, and the secondary chamber 2 overlaps the virtual band region 25. The first virtual line 23 connects the fixation end 18a, by which the string 18 is attached to the vehicle, and the fixation end 20a, by which the string 20 is attached to the vehicle. The second virtual line 24 connects the joint end 18b of the string 18 attached to the attachment part 19, and the joint end 20b of the string 20 attached to the attachment part 21. With this structure, as described above, when gas of the inflator is

supplied to the air bag 1 so as to expand the air bag, and the secondary chamber 2 also starts to expand, tension is applied on the air bag 1 by the virtual band region 25; therefore, it is possible to more reliably prevent the occupant from being thrown out of the vehicle.

[0019]

The structure of Fig. 6 is configured to achieve the same effect as that of Fig. 5. In Fig. 6, a virtual band region 28 is formed of a first virtual line 26 and a second virtual line 27, and the secondary chamber 2 is disposed to overlap with the virtual band region 28. The first virtual line 26 connects the upper end 19b of the attachment part 19, by which the string 18 is attached thereto, and the lower end 21a of the attachment part 21, by which the string 20 is attached thereto. With this configuration, as described above, when gas of the inflator is supplied to the air bag 1 and thus the air bag 1 is expanded, and the secondary chamber 2 also starts to expand, tension is applied on the air bag 1 by the virtual band region 28; therefore, it is possible to more reliably prevent the occupant from being thrown out of the vehicle.

[0020]

The structure of Fig. 7 is configured to achieve the same effect as that of Figs. 5 and 6. In Fig. 7, a virtual band region 31 is formed of a first virtual line

29 and a second virtual line 30, a plurality of secondary chambers 2, 34 and 35 is disposed to overlap with the virtual band region 31. The first virtual line 29 connects the upper end 19b of the attachment part 19 and the fixation end 20a of the string 20. The second virtual line 30 connects the lower end 19a of the attachment part 19 and the lower end 21a of the attachment part 21. With this configuration, as described above, when gas of the inflator is supplied to the air bag 1 so as to expand the air bag, and the plurality of secondary chambers 2, 34 and 35 also starts to expand, tension is applied on the air bag 1 by the virtual band region 31; therefore, it is possible to more reliably prevent the occupant from being thrown out of the vehicle.

In addition, the secondary chambers 34 and 35 are disposed in the non-inflation part 13. The secondary chamber 34 communicates with the primary chamber 7 through an opening A1, and the secondary chamber 35 communicates with the primary chamber 8 through an opening A2, and because of the openings A1 and A2, the respective primary chambers are slower to expand than the primary chambers.

In addition, as for the disposition of the secondary chambers 2, 34 and 35, the air bag 1 need not have all of them, and the tension on the air bag 1 can be controlled according to its functional purposes. For example, it is

possible to make different each time that is required for the respective secondary chambers 2, 34 and 35 to expand and develop, and thus to control the tension applied on the air bag 1, by a configuration in which the secondary chamber 2 is omitted, or by another configuration in which a portion of the secondary chamber 24 overlaps the virtual band region 31 and the entire secondary chamber 35 overlaps the virtual band region 31, or by properly choosing the area of aperture of the openings A, A1 and A2 of the secondary chambers 2, 34 and 35. Therefore, it is possible to configure the air bag 1 which ensures occupant's protection.

[0021]

Further, the location of the secondary chamber 2 is not limited to in front of the primary chamber 3. For example, the secondary chamber 2 may be located further behind the eighth chamber 10 that is located at the rearmost end of the back seat inflation part. In addition, it is unnecessary that gas be supplied to the secondary chamber 2 through the primary chamber. Gas may be supplied to the secondary chamber 2 from the gas supply port 16 through the gas supply passage 11.

In other words, modifications are allowed in the location and the number of the secondary chambers, and in the location and size of the opening for supplying gas to

the secondary chamber as long as the secondary chamber expands later than the primary chamber and an additional tension is applied on the air bag that is developed.

Further, the number of the primary and secondary chambers need not be more than one, that is, the primary and secondary chamber may be one, respectively.

[0022]

Furthermore, the invention has been described by way of the above-described embodiments, but the invention is not limited to the above-described embodiments. Various modifications and changes can be made without departing from the spirit and scope of the invention.

Industrial Applicability

[0023]

According to the invention, by disposing a chamber that is expanded by a compressed gas and another chamber that expands later than the chamber in a row, the invention may be applied to release impact on the body and reliably absorb the impact.

Brief Description of the Drawings

[0024]

Fig. 1 is a cross-sectional view showing the entire air bag according to a first embodiment of the invention.

Fig. 2 is an enlarged view of main parts of the air bag according to the first embodiment of the invention.

Fig. 3 is a cross-sectional view of the air bag 1 taken along the line C-C of Fig. 2.

Fig. 4 is a graph showing the internal pressure change of primary and secondary chambers 3 and 2 according to the first embodiment of the invention.

Fig. 5 is a view showing the relationship of a virtual band region and the secondary chamber.

Fig. 6 is a view showing the relationship of a virtual band region and the secondary chamber.

Fig. 7 is a view showing the relationship of a virtual band region and the secondary chamber.

Fig. 8 is a view showing a side curtain air bag module according to the related art.

Fig. 9 is an explanatory view showing an operation of a side curtain air bag module according to the related art.

Reference Numerals

[0025]

1	side curtain air bag
2, 34, 35	secondary chamber
3, 4, 5, 6, 7, 8, 9, 10	primary chamber
A, A1, A2	opening
18, 20	string
19, 21	attachment part
18a, 20a	fixation end

19a, 21a	upper end
19b, 21b	lower end
23, 26, 29	first virtual line
24, 27, 30	second virtual line
15, 28, 31	virtual band region